Carbon Dioxide Separation from Flue Gas By Phase Enhanced Absorption

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SUMMARY

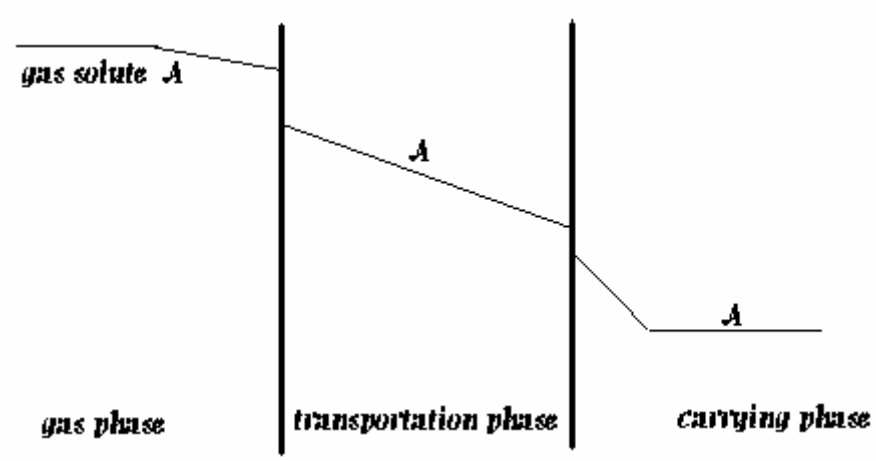
Absorption is a process by which one or more components of a gas mixture are transferred to a liquid where it is soluble. There are two types of absorption: they differ by the nature of the interaction between absorbent and absorbate. In the process of a physical absorption, the gas component being absorbed is simply dissolved in the liquid absorbent. However, the solute does not react chemically with the absorbent. In the case of chemical absorption, there is a chemical reaction between the gas component being absorbed and a component in the liquid to form a compound. In a chemical absorption, the chemical reaction between the gas solute and some component in the liquid solution enhances the absorption rate of the gas.

The phase enhanced absorption features an organic compound in addition to the traditional gas and liquid components. Adding an organic compound or mixture into the absorption system increases the absorption rate of the gas significantly. In phase enhanced absorption, more than one liquid phase is involved in absorbing the gas. One of the liquids serves as an absorbing solution (carrying phase), where the gas is ultimately accumulated. The other liquid, the transportation layer (transportation phase), plays the role of transporting the gas from the gas mixture to the absorbing solution and increasing the absorption rate of the gas. This transportation layer is composed of an organic compound and simply plays the role of accelerating the transport of the gas to be isolated (in the case carbon dioxide) from the gas phase to the carrying phase.

Due to the added organic layer, phase enhanced absorption has a unique mass transfer model. The gas to be isolated first separates from the bulk of the gas phase and comes in contact with the interface of the transportation phase. This liquid layers absorbs

the gas. The absorption is either physical or chemical. In other words, while in the transportation phase, the gas solute may react with the components in transportation phase. In the next step, the gas solute dissolved in the transportation phase passes through the interface between the transportation phase and the carrying phase, and enters into carrying phase. Once the gas is in the carrying phase, the gas solute may exist in two forms: it may be physically dissolved or in a chemical compound resulting from a reaction between the gas and a component of the carrying phase.

The function of the transportation phase is to deliver gas solute from the gas phase to the carrying phase and to increase the absorption rate. Viewed with the film theory, the phase enhanced absorption mass transfer model can be summarized in the following sketch:



MASS TRANSFER MODEL

This report examines the absorption rate of carbon dioxide with phase enhanced absorption and compares this rate to that of a conventional gas-liquid absorption method (without the transportation layer). In our experiments, carbon dioxide gas was ultimately absorbed by water and sodium carbonate aqueous solution(carrying phase). The experiments that follow are designed to demonstrate that adding a liquid phase consisting of an organic compound significantly improves the absorption rate of carbon dioxide.